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Frigaard, Peter; Margheritini, Lucia

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Preface

By request from Danida / Danish Foreign Ministry on November 9th 2011 to Aalborg University the following report has been written in order to give a 3rd party opinion on the report *Oluvil Port Development Project: Studies on Beach Erosion* written by LHI (Lanka Hydraulic Institute Ltd), June 2011.

Aalborg, November 21st 2011

Peter Frigaard & Lucia Margheritini

E-mail: pf@civil.aau.dk & lm@civil.aau.dk
Phone: +45 9940 8479 / +45 4060 8479 & 45 3095 3719

1 Introduction

Oluvil Port Development Project is the first development of a large port infrastructure in the entire eastern coastline of Sri Lanka. The project is supported by the Danish Foreign Ministry.

Feasibility studies and detailed design studies were carried out by Lanka Hydraulic Institute Ltd during the years 1995 to 2003. The design was reviewed by COWI a/s. Construction of the port was started in 2008. MT Højgaard a/s acted as contractor.

The outer breakwaters were constructed as first part of the project. During and after completion of the breakwaters a serious beach erosion and sand accumulation has been observed. Severe erosion is seen north of the harbour and some accumulation of sand is seen south of the harbour.

On a sandy coastline like the one in Oluvil such erosion problems as observed are very typical.

The report: Oluvil Port Development Project: Studies on Beach Erosion written by LHI (Lanka Hydraulic Institute Ltd), June 2011 describes calculation of erosion and sediment transport under some proposed coastal protection scenario.

2 Overall description of the sediment problem

The coastline on the east side of Sri Lanka consists of gentle sandy beaches with fine sand. Wave heights are typically in the range 0.5 to 2 meters. Severe longshore sediment transport must be expected in such a dynamic area.

Waves coming from southerly directions will create a longshore sediment transport going from south to north. This longshore sediment transport will result in deposition of sand in the harbour entrance plus erosion on the lee side of the harbour (north) and accumulation of sand on the south side of the harbour.

Likewise, waves coming from northerly directions will create a longshore sediment transport going from north to south. This longshore sediment transport will result in deposition of sand in the harbour entrance plus erosion on the lee side of the harbour (south) and accumulation of sand on the north side of the harbour.

When the two effects described above are summed the net erosion and accumulation can be calculated.

It should be clear that the erosion can shift from side to side of the harbour from year to year depending on actual waves.

3. Methods and data used to quantify erosion

Longshore sediment transports / erosions / accumulations are normally calculated using a numerical model taking the bathymetry, descriptions of the sands and statistics on the waves and currents as input. There exist a handful of well recognised models on the world marked.

Lanka Hydraulic Institute Ltd has used a set of models from DHI Water and Environment named MIKE 21. The used set of models MIKE 21 –NSW, MIKE 21 – PMS, Mike 21 – HD and MIKE 21 - ST is today a proven industry standard and certainly among the best available models.

The staff at Lanka Hydraulic Institute has been trained by staff from DHI Water and Environment, and there are no indications that the model calculations are not performed as they should be.

The quality of any numerical calculations will never be better than the quality of the input data for the model. It must be mentioned that the state of the art within modelling of sediment transport is on such a level that results within a factor 5 often is considered to be satisfactory. The reason for this is that amount of sediment being transported is extremely non-linear in respect to practically all input parameters.

In the report it can be read: According to the Feasibility Study Report in 1998, south of the Oluvil port would record a net erosion of 50,000-70,000 m3 whereas north of the port would experience accretion of 20,000-40,000 m3. Given the fact that the breakwater construction is now over, south of the port is heavily silted contradicting the figures in the Feasibility Report. This apparent discrepancy is somewhat rectified in the subsequent report claiming a net accretion of 30,000-40,000 m3 in south. Although this is still far from the observed figure of 250,000 m3 (only during SW monsoon in 2009), it proved the fact that incorporation of enhanced wave data yields better and improved model predictions.

The calculations in the report are performed using wave / wind data from two campaigns (96/97) and (98/00). From the citation above it is clear that better statistics on the data is needed in order to give any quantitative values on the sediment transport.

Year	*Calculated*	*Observed*	*Comments*
96/97	Erosion 50,000-70,000 m3		
96/97+98/00	Accretion 30,000-40,000 m3		Data from the 2 used campaigns
2009		Erosion 250,000 m3	

The table above demonstrates the difference in the available figures. The difference must be divided in two categories. The first category covers natural variability in wave / wind data from year to year (and in the future). The second category is uncertainties using the existing numerical models.

It must be noticed that large variations from year to year is expected in the overall erosion picture. The lack of statistical data makes all calculated quantities and conclusions indicative.

The calculations and methods used in the analysis are all up to date, and follows best practice in the field.

4. Proposed Coastal Protection North of the Harbour

Three different solutions for the erosion problem have been examined. The solutions are Offshore Breakwaters, Fish Bone Groynes and Artificial Nourishment. These solutions cover the usual methods for coastal protection in similar situations excluding submerged breakwaters.

Variations of the proposed solutions could have been examined, but the three actual proposals covers the possibilities in a fair way. Nevertheless, the proposed Offshore Breakwaters as well as the Fish Bone Groynes are cheap variations of the two possible solutions. The Breakwaters are shorter and closer to shore than often seen. The length of the Fish Bone Groynes and the distance between them are shorter than often seen. Both solutions are expected to work in the sense that they will decrease erosion, but they will not stop the erosion.

The report under review recommends using offshore breakwaters argued in calculated lower erosion figures. The calculated erosion quantities shall not be trusted too much, but from solution to solution they can be compared relatively.

It could be argued that Artificial Nourishment is a good solution as the erosion might shift from north to south in some years, but on the other hand has it often been seen that beach nourishment programmes has been neglected in the long term.

The use of offshore breakwaters is supported.

5. Overall assessments

Erosion and sediment accumulation must always be expected around Oluvil Harbour. Severe erosion has been observed north of the harbour in 2009. In a year with more frequent waves coming from north this erosion could shift to be south of the harbour.

The report under review proposes three relevant solutions to the erosion problems in Oluvil. The proposed solutions cover more or less possibilities to protect the beach. The methods and the analysis used to assess the proposed solutions reflect state of the art. A comparative numerical exercise evaluating the proposed solutions is only slightly depending on the input data as the same data is used for all calculations and conclusions can therefore be taken from the study.

The wave / wind data used for the calculations must be criticised as it covers too short periods to give a satisfactory statistics. Moreover, rather large deviations in the wave / wind statistics seem to be possible from year to year. Therefore the calculated quantities shall only be taken indicative.

The beach around Oluvil has an erosion problem. Offshore breakwaters are well proven structures to stop or minimize erosion. The recommendation to build offshore breakwaters north of the harbour as described is supported in its basic idea. Still there is a high risk that the erosion will move further up north, and there is a risk that some erosion will occur south of the harbour, but no other solution seem to be better. Need for more protection works in the future is foreseen.

The problem is interesting and complex. A more detailed proposal for a solution will require much more data and deeper investigations.

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